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Research article

Challenges to organic farming: A literature review on its sustainability and adoption using rice (*Oryza sativa* L.) in Kapatagan, Lanao del Norte, Philippines

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Abstract

Productive farmlands suffered degradation due to intensive usage of synthetic pesticides and fertilizers. Hence, the concept and practice of organic agriculture is introduced to gain back the lost natural fertility of the soil. A key policy in the Philippines led to the enactment of a national legislation on organic agriculture. It described farming technology that maximizes cost-effectiveness, reduce pollution and augment the standard quality of living among the farmers. This review paper, therefore, presents some challenges, information gaps, information related to organic agriculture and relevant scientific findings such that these information might help the organic rice farming initiatives undertaken at Kapatagan, Lanao del Norte, Philippines. This could help farmers and other relevant stakeholders who opted to do organic farming.
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Keywords: rice, organic agriculture, Lanao del Norte, sustainable development

Introduction

Farmlands are eminent land-use since time immemorial, wherein agriculture is an ancient form of livelihood. In this case, rice land becomes depleted of its natural fertility due to massive application of inorganic and chemical fertilizers and pesticides. Not only the terrestrial environment that is being affected but it also caused depletion of ozone layer and changing climatic conditions. This in turn, destroys life forms on earth's surface

including health concerns of the human beings. Given the challenges that arise from the ill-effects of agro-chemicals, a key policy intervention for sustainable agriculture is deemed important and enacted. This aimed to encourage the adoption of agricultural technologies that rely to a greater extent on local or renewable resources. Organic farming is one such technologies that can reduce the harmful impacts of agro-chemicals, and is considered by many scientists to be the best form of agriculture in terms of maximizing cost-effectiveness and minimizing pollution (Christian et al. 2005).

One area in the Philippines is in Kapatagan, Lanao del Norte, which is known as one of the rice-producing areas in Mindanao, yet suffered some serious environmental impacts due to excessive use of synthetic pesticides and fertilizers in their farms. Hence, the agriculture sector strived to implement organic rice farming due to availability of organic materials that can be used in the rice farms. Lanao del Norte areas have plenty of sources for organic matter production such as compost from rice straw and organic manures from farm animals and livestock. Leftover such as leaf litters, termed as 'green manure' from farms and gardens can be converted into organic fertilizer with the help of friendly animals, the earthworms. Manures from farm animals can also be a source of organic fertilizer. Further, organic rice production gained popular importance among the constituents in Lanao del Norte due to its significance and cost-effectiveness.

Organic agriculture has continued to grow substantially despite the world economic crisis. It is now being viewed as an additional option to conventional or 'chemical' agriculture and not just for the niche market. But uncertainties remain that it can be an alternative option that could feed the world. The reported organic area in the Philippines is just 52,500 hectares but the government support for organic agriculture became more emphatic and accelerated in 2010 with the passing of the "Organic Agriculture Act of 2010" or RA 10068 which provides for its development and promotion in the country (Maghirang et al., 2011). Organic agriculture, therefore, can contribute to meaningful socio-economic and ecologically sustainable development, especially in poorer countries. This is due to the application of organic principles, which means efficient management of local resources (e.g. local seed varieties, manure) and therefore, cost-effective. Central to organic agriculture is the promotion of soil fertility, biodiversity conservation (e.g. native flora and fauna), production methods adapted to the locality and avoidance of chemical inputs. These methods, together with cultivation of a diverse range of crops, stabilize the delicate ecosystems in the tropics and reduce drought sensitivity and pest infestation. Organic agriculture reduces the risk of yield failure, stabilizes returns and improves the quality of life of small farmers' families (Kilcher, 2007).

As of today, sustainable agriculture appears to be the most popular, government-supported farming programs. It is an integrated system of plant and animal production practices having a site-specific application that will, over the long term, satisfy human food and fiber needs, enhance environmental quality and the natural resource based on which the agricultural economy depends, make the most efficient use of non-renewable resources and on-farm resources and integrate, where appropriate, natural biological cycles and controls, sustain the economic viability of farm operations, and enhance the quality of life for farmers and society as a whole country (Maghirang et al., 2011). Hence, organic management has become one of the most popular sustainable strategies to produce agricultural goods but reduce negative environmental effects of intensive agriculture such as biodiversity decline (Zechmeister, 2003; Tscharntke, 2005; Whittingham, 2011).

Food availability, access, stability and utilization are all part of the multi-dimensional nature of food security. Organic agriculture is considered an interesting option for sustainable agriculture in developing countries because it offers a unique combination of low external input technology, environmental conservation and input/output efficiency. It also provides access to premium price markets through labeling. NGOs and farmers' groups are increasingly adopting organic agriculture techniques as a method of improving productivity and food security. At the same time, critical voices raise concern that organic agriculture is not capable of meeting the world's growing food needs due to low productivity per unit area (Borlaug, 2000; Trewavas, 2002).

Organic farming is but one of the options for environmentally-sustainable agricultural production. Surely, it is the most radical form of sustainable agriculture and the only approach which has long been defined and implemented within the framework of a complex system of laws and regulations that have progressively become established and acknowledged (Pugliese, 2001). Organic agriculture is one of the livelihood options being offered tofarmers in the Philippine Agriculture 2020 agenda.

METHODOLOGY

Literature reviews were conducted based on published articles in peer-reviewed journals both national and international in scope that were downloaded freely from various journals especially the open-access journals. Information gaps and other important information on organic agriculture were sourced out and noted. The concept was therefore formulated and written in terms of the objectives and research process flows that could be applicable in Lanao del Norte setting.

RESULTS OF INFORMATION AS REVIEWED

Organic farming and soil conditioning

Organic farming is the subject of extensive research in northern countries, especially in Europe. A wide range of studies (Offermann and Nieberg, 2000; Stolze, et al., 2000; Mäder, et al., 2002 Offermann and Nieberg 2000, Stolze et al. 2000) have demonstrated the advantageous aspects of this system in terms of ecosystem functioning, soil fertility conservation and economic impact. To this, the concept of vermicomposting is one of the breakthough technologies related to organic agriculture.

Vermicompost is a nutrient-rich, microbiologically-active organic amendment that results from the interactions between earthworms and microorganisms during the breakdown of organic matter. It is a stabilized, finely divided peat-like material with a low C:N ratio, high porosity and high water-holding capacity, in which most nutrients are present in forms that are readily taken up by plants (Domínguez, 2004). Unlike compost, vermicompost is produced under mesophilic conditions, and although microorganisms degrade the organic matter biochemically, earthworms are the crucial drivers of the process, as they aerate, condition and fragment the substrate, thus drastically altering the microbial activity. Earthworms act as mechanical blenders, and by fragmenting the organic matter they modify its physical and chemical status by gradually reducing the ratio of C:N and increasing the surface area exposed to microorganisms, thus, making it much more favorable for microbial activity and further decomposition (Domínguez, et al., 2010).

Vermicompost does not have any adverse effect on soil, plant and environment. It improves soil aeration and texture thereby reducing soil compaction. It improves water retention capacity of soil because of its high organic matter content. It also promotes better root growth. The effects of a variety of vermicomposts produced from cow manure, sheep manure, poultry manure, goat manure (mixed with carpet underfelt, lawn clippings, cardboard, and domestic waste), kitchen scraps, cardboard (mixed with wheat, maize, meat, lucerne and linseed meals, rice pollard and oat hulls), and pig wastes on plant growth. Stimulating effects of pig manure vermicomposts on the growth of soybeans (*Glycine max)*, particularly in terms of increased root lengths, lateral root numbers, and internodes lengths of seedlings (Chan and Griffiths, 1988). In another rooting experiment, that used vermicomposts improved in the establishment of vanilla (*Vanilla planifolia)* cuttings better than other growth media such as mixtures of coir peat and sand (Siddagangaiah et al., 1996).

Organic agriculture and farmers' perceptions

To promote further spread of organic agriculture for sustainable development, there is a need to better understand the farmers' view point. Consumer's interest in organic food is influenced by their belief that organically produced food is safe and better for health, environment and welfare of farmers and the society. Health and safety concerns and environmental issues are the predominant motives for conversion, whereas economic motives are of lesser important. Sustainable agricultural practices (SAPs) that lead to an increase in productivity are central to the acceleration of economic growth; this will alleviate poverty and help to overcome the recurrent food shortages that affect millions of households. Despite the improvements made over the last four decades in the agricultural sector, a combination of declining soil fertility, population growth, low uptake of external inputs, and climate disruption has resulted in a dramatic fall in per capita food production (Pretty et al., 2011). This has led to more hunger and poverty in the region. Problems experienced during conversion relate to lack of governmental and institutional support, less use of chemicals and improved food quality were highly ranked as benefits.

Sustainable farmers achieved higher score on sustainable agriculture paradigms compared to conventional farmers (Comer et al., (2008). The results also show that farmers' affiliation with different organization/groups does affect their perception about organic agriculture. Most of the farmers involved in agriculture activities are male and

married in both organic and conventional farming. The average age of the farmers lie between 45 to 50 years old and size of the family figured at 6-10 members where in most cases 1 member were involved in farming. More than 90% organic farmers adopted organic method of cultivation in 2009 and after conversion it has found that they are more concern for environmental responsibility, conscious towards society and democratic rights which could bring them into the mainstream. Further, socio-economic condition of the organic farmers has strengthened and their access to the banking facilities, training, electronic accessories and mode of transport has gradually increased and policy makers need to better understand how production systems intersect with the farmer life-cycle and the farm business-cycle. An individual's role and responsibility in the farm household and farm business change as they age. The way farm families organize and manage both the division of labor in the household and the farm enterprise has important implications for farm adaptation and persistence. In highly diversified operations, for example, the older generation may be the primary producer(s) while the younger generation may be more engaged with the marketing aspects of the business. This division of labor raises questions about the long term-viability of the production function of the farm enterprise.

The persistence and growth of agriculture is partially dependent on policy and community environments that can provide the social and economic infrastructure farm families need (Sureshwaran and Ritchie, 2011). A responsive policy environment must include the social and cultural factors that influence farm economics and farm structure. There is a need to develop farm transition policies and technical assistance programs that are aligned with the values and needs of different types of farmers and their households (Inwood, 2013). Government can play critical role in motivating the farmers towards organic farming by providing training and conversion compensation or subsidy which is expected to occur during conversion period. Further, government should provide at district level advisory/expert services to deal with the marketing aspects, crops disease, proper use of organic manure, certification issues and establish group of farmers to uplift the concept of "community farming" which reduces overall cost of cultivation too. Further, at district level government should plan for awareness program thereby local demand of organic food will generate which will motivate farmers to adopt organic farming (Azam, 2015).

Organic farming and socio-economic concerns

Organic farming adoption determinants can be classified into two broad groups: non-economic and economic factors. The former group includes farmer's attitudes, opinions and objectives as relevant elements. In the later group, it is mainly finding market prices, profit making and public support. Most studies (Burton, et al., 1999; Rigby et al., 2001; Padel, 2001) that have analyzed the adoption of organic farming have found the relevance of both types of factors. In this line, attitudes and preferences are important determinants of adoption decisions (De Cock, 2005; De Souza**,** et al., 1999; Burton, et al., 1999; Ajzen and Fishebin, 1977). While differences in attitudes and opinions between organic and conventional farmers can contribute to explain conversion, they can usually interact and influence each other in a complex form (De Cock, 2005). The importance of the environmental over the economic considerations is a basic factor in the decision to adopt. The commitment of organic farmers to the preservation of the environment and the generation of economic activity are important determinants to conversion (Kallas, et al**.**, 2009). Several parameters have been identified as influencing the adoption behavior of farmers and social scientists investigating farmers who adopt the technology showing the demographic variables, technology characteristics, information source, knowledge, awareness, attitude and group influence affect adoption behavior (Oladele 2005). To adopt the organic agriculture, one of the aspects that should be considered is to establish balance in environmental activities. The main methods that accelerate this process are: protection of water resources and prevention of soil erosion, awareness, the use of local varieties, reduced chemical inputs, the use of biological control to combat pest and diversification of agricultural activities (animal husbandry, agriculture and horticulture).

The other aspect is social dimension. Major issues that lead to social stability in agricultural activities included: prevention of migration of rural people, improving quality of life in rural areas, improve technical knowledge of farmers in organic agriculture, and development of participation and cooperation among rural population. Another aspect that influences the adoption of organic agriculture is economic stability. To achieve economic stability, following factors must be considered: stabilizing the price in various agricultural products, reducing the role of middle men in marketing products, creating balances between supply and demand in agricultural products, considering short term and long term incomes, enhancing the grounds for competition among farmers and finding the appropriate strategies to attract investment in agriculture sector (Hersman, 2004).

Organic agriculture was developed as a farming system that is specifically aimed at producing food in a more environmentally friendly way. On a per unit area basis, organic agriculture has been shown to have several

environmental benefits compared to conventional agriculture. It reduces pesticide use, it can increase species abundance and richness (Bengtsson**,** et al.**,**2005; Hole**,**et al.**,** 2005), reduce soil erosion (Siegrist**,** et al.**,**1998), increase soil fertility (Leifeld and Fuhrer**,** 2010), use less energy and reduce agricultural greenhouse gas emissions (Gomiero**,**et al.**,**2008), and reduce nitrogen losses from the system (Drinkwater**,**et al.**,**1998).

Organic farming and environmental and health concerns

On some environmental issues, like soil carbon storage or water pollution through nitrate and phosphorus leaching, the better environmental performance of organic agriculture is, however, not totally unambiguous (Kirchmann and Bergström**,** 2001; Mondelaers**,**et al.**,**2009). Organic agriculture is developing rapidly and at least countries produce organic food commercially (Reddy, 2010). The major goal of organic farming is sustainable production of quality food with little or no effect on the environment (Herath and Wijekoon, 2013).The "adoption of an innovation is related to innovation-decision process through which an individual (or other decision-making unit) passes from first knowledge of an innovation, to forming an attitude towards the innovation, deciding to adopt or reject the innovation, implementing the new idea, and confirming the innovation decision" (Rogers, 1995).Adoption models are generally based on the theory that farmers make decisions in order to maximize their expected profits or utility. On the other hand, farmers' utility is dependent on optimizing productivity and minimizing the costs of cultivation to attain maximum profits. Feder et al. (1985) stated that farmers adopt or practice new technologies when they expect a more profitable outcome than that gained from existing technology. Optimizing utility may also include considerations such as health benefits, environmental concerns, food security and risk (Ribaudo, 1998; Napier**,** et al**.**, 2000).

The concept of sustainable agriculture is strongly related to the multifunctional role, either explicitly or implicitly, recognized to the primary sector (Parra-Lópeza, et al**.**, 2008). This sustainability approach comprises a social, an environmental and to a lesser extent, an economic dimension. It takes into account the needs of rural communities and food safety for consumers as well as the impact of agricultural practices on local ecosystem services and the global environment (Aerni, et al**.**, 2009). One aspect of sustainable agriculture is the efforts of many governments to adopt organic farming, in order to control the destruction of natural resources and decrease the amount of chemical inputs in agriculture sector. A wide range of economic, social, physical and technical aspect of farming influences adoption of organic agriculture. The factors which influence the adoption of new innovations by farmers are those based on perceptions about risk and profitability; uncertainty and certainty about adoption; amount of required information and attitude about risk and uncertainty (Wheeler, 2005).

Output: Literature review to research conceptualization

Based on the literature review conducted, a study is conceptualized and entitled "**Organic rice farming and production: Implications to rice*(Oryza sativa L.)*resource sustainability and management in Kapatagan, Lanao del Norte, Philippines**". This is composed of interrelated three chapters: Chapter 1 is developed to revolve on the title "**Growth and yield of organically grown rice (*Oryza sativa* L.)inKapatagan, Lanao del Norte, Philippines**" This has expounded on the growth and yield of rice using the organic farming technology. This is a field experimental study using the different number of seedling densities and applying vermicastand animal manures as soil enrichment. Chapter 2 dealt to address socio-economic issues emphasized in the title "**Adoption and challenges of organic rice farming in Kapatagan, Lanao del Norte, Philippines**". This has included the characterization of the socio-economic conditions of the farmers and their perceptions on the adoption of the technology of organic rice farming and their inherent challenges. Chapter 3has integrated all the outcomes of Chapter 1 and Chapter2 together with various views of the farmers on the sustainability and management issues on the adoption of the organic rice farming technology towards increase rice production in Kapatagan, Lanao del Norte. Thus, Chapter 3 is entitled "**Implications of organic rice farming, growth and yield of rice, adoption and challenges on rice production management and sustainability**".

The three chapters were developed and implemented on the bases of the following objectives: (1) to determine the agronomic parameters that affect the growth and yield of organically-grown farmed rice (*Oryza sativa*, L.)planted at varied planting densityinKapatagan, Lanao del Norte, Philippines; (2) to describe the status of the current adoption and the inherent challenges and to assess the LGU management strategies of the organic rice

farming practices in Kapatagan, Lanao del Norte; and (3) to determine the implications that the growth and yield of organically grown rice, adoption and challenges of the organic rice farming may have to rice resource sustainability and management.

Based on the objectives and conceptual framework as further articulated in the research problems, a general flow chart of the research process (Figure 1) and methods (Figure 2) involved in the study are laid down as guides in the conduct of the study.(Figure 3). The flow chart of the research process (Figure 2) explicitly shows the issues and parameters affecting the growth and yieldof *Oryza sativa*, the adoption and challenges of the organic farming technology as well as the implication and the problems of the study as they relate to the null hypotheses.

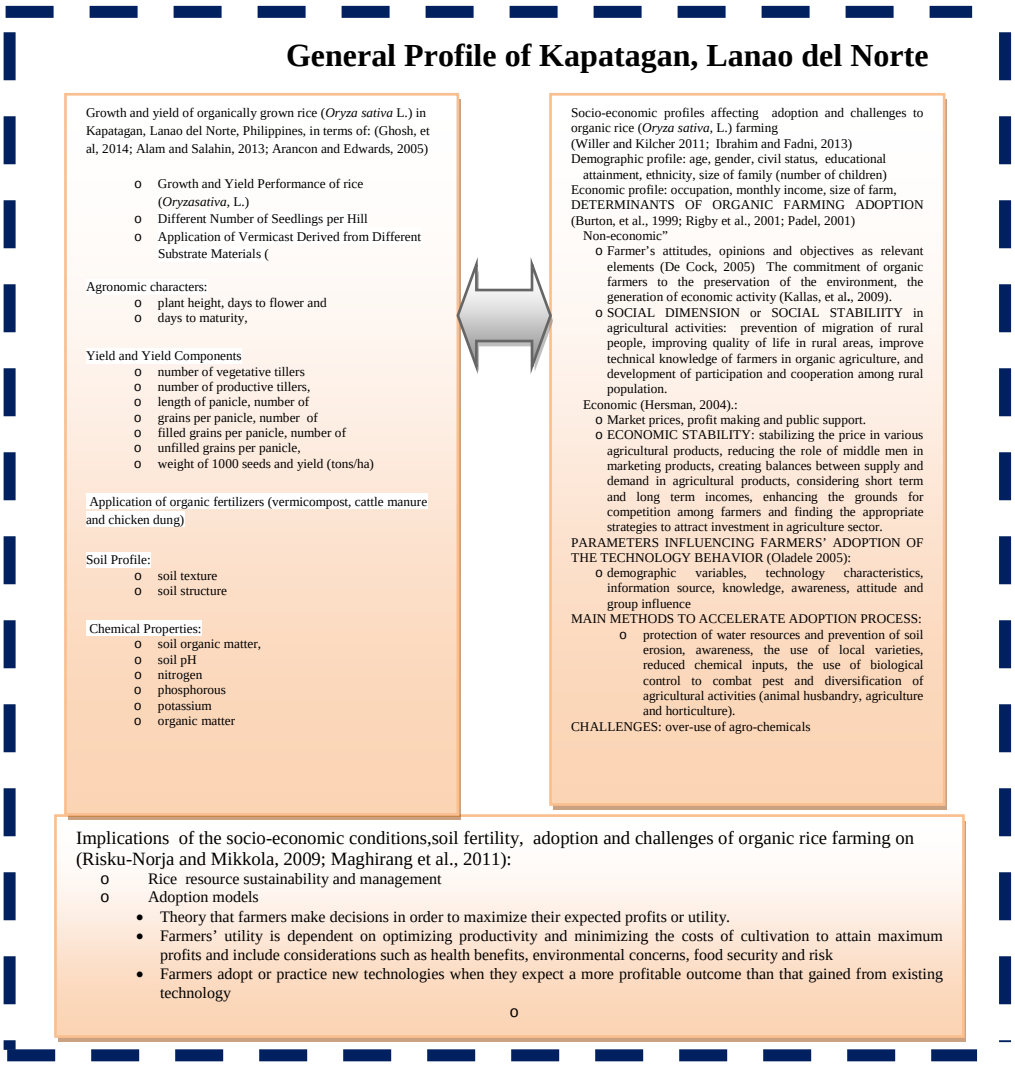

Figure 1. Soil fertility assessment of organic rice farming, socio-economic conditions, technology adoption and challenges and their implications on rice resource production sustainability and management.

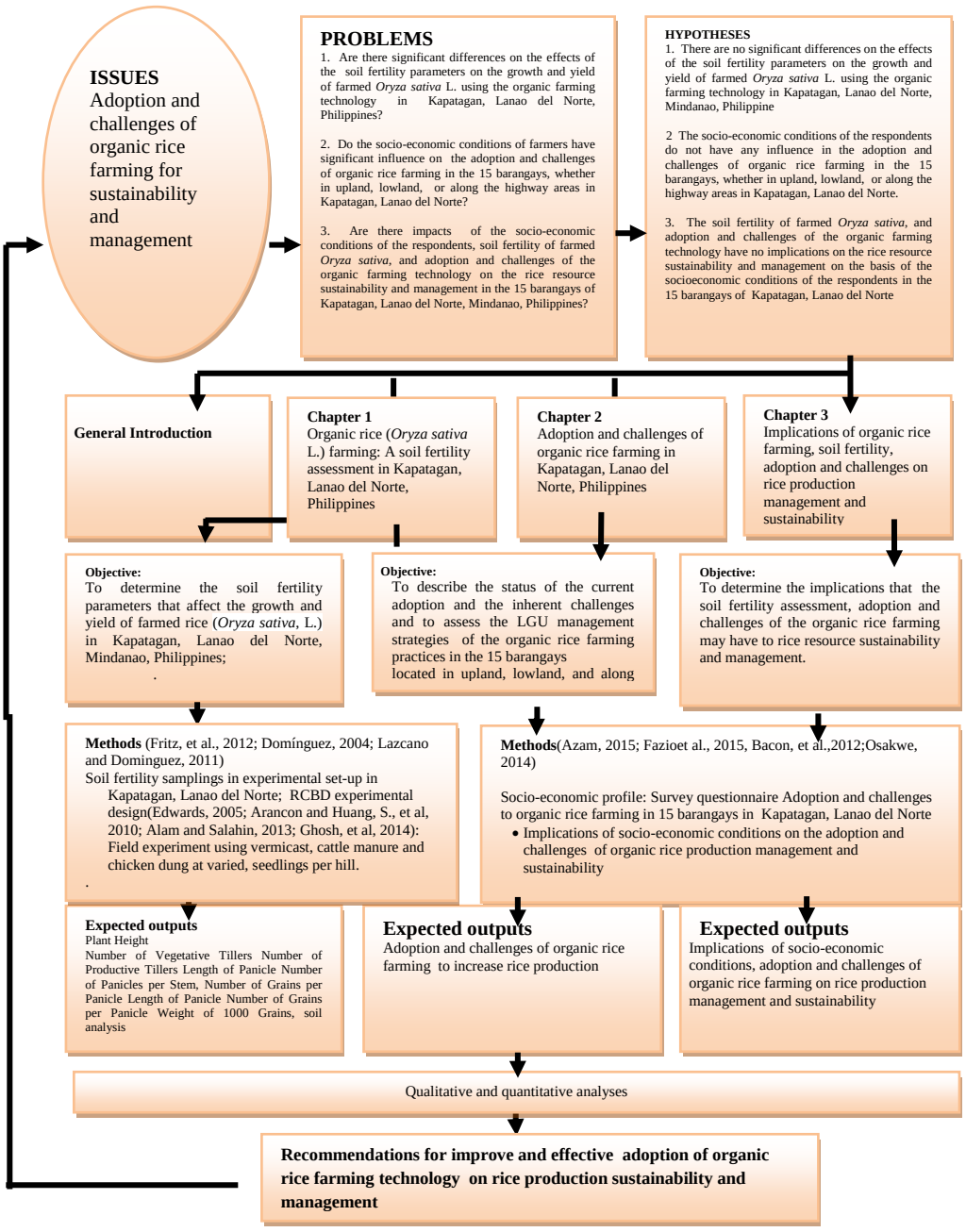

Figure 2. The research process involved in the study in relation to issues, problems, hypothesis and objectives of the study.

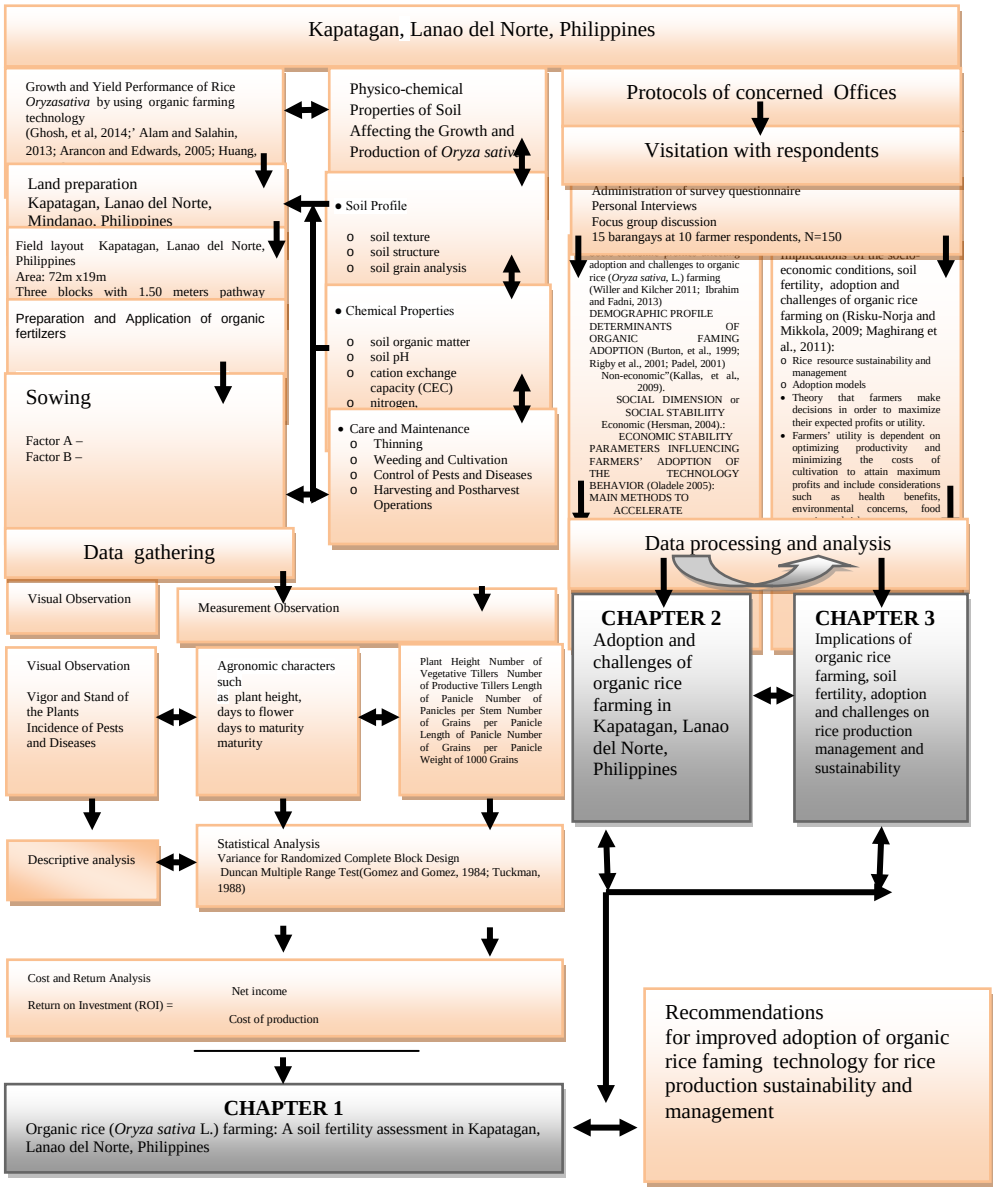

Figure 3. General flow chart of methods involved in the conduct of the study.

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